The Value of ERP Curriculum Integration: Perspectives from the Research

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ABSTRACT

In the current economic conditions, many institutions face dwindling budgets and an increased focus on proving the value of the education provided. The effort and costs required to integrate Enterprise Resource Planning systems into course curricula are a significant investment of resources for any university. This paper examines the expense of Enterprise Resource Planning integrated curricula (ERP-ICs) and the documented benefits. Evidence is still needed to place a quantitative value on many of the benefits provided to students completing an ERP-IC and to the college and university making that investment. A review of research literature regarding Enterprise Resource Planning based curricula is summarized in relation to costs and benefits. Benefits documented with quantified research are specifically examined. Finally a discussion of important benefits and costs that have yet to be quantified is given. In this age, universities are examining the cost-benefits of each investment and research on ERP-ICs lacks the data to make this case. Additional research is suggested to enrich this field of research beyond the current case studies and curriculum models.

Keywords: Enterprise resource planning (ERP); Curriculum design and development; Learning goals & outcomes

1. INTRODUCTION

In the 1990s, Enterprise Resource Planning (ERP) systems were a significant investment for many companies. Following this investment by industry were numerous efforts to incorporate ERP experiences into business education curricula. ERP integrations into curricula require a significant investment of resources. First, an investment in ERP software and hardware assets must be made to build the requisite assets on which to base coursework. Next, faculty must build the system skills necessary to be qualified instructors and to create coursework integrated with university level objectives (Becerra-Fernandez, Murphy, and Simon, 2000; McCann and Grey, 2009; Watson and Schneider, 1999). Next, information system personnel must be trained to administer, operate, and maintain the selected ERP system (Becerra-Fernandez, Murphy, and Simon, 2000; McCann and Grey, 2009; Watson and Schneider, 1999). Though some ERP vendors have aided the process through free software or hosting services, one study found the investment of funds and IT support staff was still too high for many institutions to attempt ERP integration into their curricula (Bradford, Vijayaraman and Chandra, 2003).

In an attempt to perform a cost-benefit analysis for integrating an ERP system into the business college curriculum, we examine ERP research and literature to identify the benefits gained from integrating ERP system usage into business school curricula. Though many advantages and benefits of hands-on ERP experience are discussed, specific quantitative improvements as a result of the investment in ERP curricula are rarely documented (Grandzol and Ochs, 2010; Hawking, Ramp and Shackleton, 2001; Mandal and Flosi, 2012; McCann and Grey, 2009; O'Sullivan and Stewart, 2010; Watson and Schneider, 1999). Our research efforts sought evidence of increased business knowledge and understanding, increased student placement, or an increase in graduates' salaries after investment in the ERP-IC. In addition, we looked for benefits that accrued to the institutions creating the integrations such as increased credibility of the college or university among organizations that employ graduates, attraction of qualified faculty, and evidence that an ERP-IC across business disciplines creates a better, and more realistic learning environment.

2. LITERATURE REVIEW

Several drivers increased the presence of ERP systems in business organizations. The first driver was the need to integrate information from different functional areas of an organization into one system (Mandal and Saputro, 2008; Madapusi and D'Souza, 2012). A second driver was the move away from legacy systems prompted by Y2K incompatibilities (Mandal and Saputro, 2008). Also, the need to comply with the 2002 Sarbanes Oxley Act, which

demands greater control and traceability of all transactions impacting financial statements, drove even more businesses to adopt ERP systems (Mandal and Saputro, 2008). Finally, research has shown that ERP investment improves an organization's performance (Madapusi and D'Souza, 2012). Most large and medium-sized organizations are utilizing ERP systems now to track and manage their business (Mandal and Flosi, 2012). In 2013, Forbes reported the global ERP market revenue had reached over $24 billion (Columbus, 2013).

As ERP system usage grew, business schools believed their students should experience the ERP systems first hand. In part, that is because ERP systems create an increased emphasis on cross-functional business processes, decision making, cooperation and coordination within organizations that use the systems (Kanthawongs, Wongkaewpotong and Daneshgar, 2010; Bradford, Vijayaraman and Chandra, 2003; Boykin and Martz Jr., 2004; Mandal and Flosi, 2012; Fedorowicz, et al. 2004).

In addition, a survey by Duplaga and Astani finds that "The number one problem for organizations of all sizes was *lack of ERP training and education*...firms of all sizes also agreed on the second highest rated problem: *lack of in-house expertise in ERP"* (Duplaga and Astani, 2003; emphasis in the original). Thus, integrating ERP into the curriculum would appear to benefit the education of business students as well as aid their future employers. Researchers seeking evidence of these benefits may be surprised. Many schools invested a significant amount of time and money to define and launch integrated ERP curricula into their business schools (Becerra-Fernandez, Murphy, and Simon, 2000; McCann and Grey, 2009; Watson and Schneider, 1999; Fedorowicz, et al., 2004), but quantitative evidence of the benefits are scarce in research literature.

Some faculty expected to gain increased recognition from external stakeholders through the launch of the ERP-IC (Becerra-Fernandez, Murphy and Simon, 2000). Faculty also expect their graduates to be more marketable due to the ERP-integration efforts (Mandal and Flosi, 2012; Hawking, McCarthy and Stein, 2004; Fedorowicz, et al., 2005). Rosemann and Maurizio's survey (2005) shows that many faculty believe their ERP-integration efforts created an increase in student demand, employer interest, and employer demand for their students, though no research has quantified the increase to aid analysis.

Some have asserted that the "theoretical" content of a course is the source of its academic integrity. This theory-versus-skills discussion has been present in the IS literature for some time: "The graduate of an IS program should be equipped to function in an entry-level position and should have a basis for continued career growth" (Couger et al., 1995, p. 345). Couger and his co-authors were of course referring to the soft skills that are necessary if a graduate is to make contributions to organizational management, strategic decision making, and innovation in the environment of the present and future.

Building on others, Grandzol and Ochs (2010) claim that one major benefit for the Business curriculum is better integration and interaction among the functional areas: "The question is how to take advantage of ERP to facilitate curriculum integration while addressing accreditation and assessment requirements, organizational structural issues, technical support, faculty needs and rewards, business demands, and employment market realities" (p. 18). The basis for the claim of potential improvement in the overall business curriculum is the writing of Porter and McKibbin (1988) who emphasize the difference between the complex, interactive business processes in the real world and the segmented, siloed curriculum of the average Business school.

A variety of resources are needed to accomplish ERP curriculum integration. ERP software is acquired and hardware assets purchased to host the system. Some ERP vendors offer hosted ERP solutions which reduce or avoid the cost of implementing and maintaining the ERP software. Research shows that universities are typically more satisfied using an ERP system hosted by those with this expertise, such as the University Competence Centers designed by SAP (Rosemann and Maurizio, 2005). The skills and knowledge required to implement smaller ERP systems are not especially difficult but the effort requires diligence to avoid interoperability problems among multiple required components (Edwards and Hepner, 2010).

However, significant resources must still be expended in terms of faculty training and preparation time (Bradford, Vijayaraman and Chandra, 2003; McCann and Grey, 2009; Watson and Schneider, 1999). For example, one integration effort used a hosted solution yet still found significant time spent resolving issues that occurred between the ERP client software and hosted system, conflicting schedules of the host university and client university, and conflicting versions in the exercises being used and the actual hosted version of the ERP system (Davis and Comeau, 2004).

Whether using a hosted system or not, staff familiar with the operation of the system may be needed to set up users, set up databases for course exercises, and to satisfy common user complaints (Bradford, Vijayaraman and Chandra, 2003). Personnel with ERP skills are typically in high demand making them difficult to hire and to retain. These personnel are critical to the success of the ERP curriculum integration efforts (Bradford, Vijayaraman and Chandra, 2003; Becerra-Fernandez, Murphy and Simon, 2000; Boykin and Martz Jr., 2004; Watson and Schneider, 1999).

Faculty must be given release time to gain the necessary ERP system knowledge and experience. ERP system understanding is typically gained through vendor provided training. Once familiar with the system, faculty may create the student ERP exercises and experiences or incorporate provided exercises into an existing course. A great deal of training must be completed before faculty are able to gain the perspective and system skills to enable proper incorporation and management of ERP activities into a course (Fedorowicz, et al., 2005). Ensuring sufficient training depth is the only way to be certain faculty are able to instruct students on the use of the system in a larger context (Bradford, Vijayaraman and Chandra, 2003; Becerra-Fernandez, Murphy and Simon, 2000) and avoid the criticism some ERP vendors receive when providing step-by-step key stroke instruction which provides no understanding of the greater reasoning behind the transactions (Davis and Comeau, 2004).

Even when ERP exercises are provided to faculty, these must be adapted to fit the specific course objectives (Fedorowicz, et al., 2004). This effort on the part of faculty is time consuming and difficult. One ERP curriculum integration effort lost over 50% of the faculty from their original project team which was formed to support the ERP integration into curriculum (Becerra-Fernandez, Murphy and Simon, 2000; Murphy, 2007). Hawking and colleagues report that out of thirteen universities that originally joined the SAP alliance in Australia, only seven remained due to key faculty changing direction or leaving (Hawking, McCarthy and Stein, 2004). Even when universities commit the resources necessary to acquire the software, hardware and personnel resources, faculty may be left to their own devices for ERP education. One survey found that seventy-four percent of the faculty were required to teach themselves the ERP system (Bradford, Vijayaraman and Chandra, 2003). Some institutions have creatively approached the resource issues by offering an MIS course that turns its students into "ERP Consultants" for the rest of the college's business majors who take ERP-integrated courses (Boykin and Martz Jr., 2004). In summary, integration itself was considered a difficult project by many, and that was true regardless of which ERP system, or which platform, was selected for curricular integration (Bradford, Vijayaraman and Chandra, 2003).

Training for faculty and staff will be continuous due to faculty and staff turnover as well as ERP version updates (Hawking, McCarthy and Stein, 2004; McCann and Grey, 2009; Watson and Schneider, 1999). Initial hardware and software configurations may need to be scaled to handle additional course and student work load if the ERP curriculum integration expands to more courses. Other ongoing costs include increased student printing for both online ERP help and for the business process definitions created inside the ERP system (Watson and Schneider, 1999). Ongoing curriculum modification must be considered due to the evolution of the ERP system through updates (Esteves and Pastor, 2001; Fedorowicz, et al., 2005). Maintenance activities are needed at the beginning and end of each semester to set up student accounts and recreate data used by students during coursework. Less frequently, hardware may require upgrade to support ERP version upgrades. More difficult to estimate are the lost opportunity costs associated with the significant time and effort that faculty members invest in the ERP curriculum integration (Watson and Schneider, 1999).

Some universities provide a single ERP-integrated course. Other approaches vary greatly. An IS-focused integration is demonstrated by Lamar University described in Mandal and Flosi (2012) who integrate their curriculum starting in a student's freshman year with additional complex business transactions in the student's junior year. All courses are taught by the IS department. One freshman course and

Resources/Challenges (Adapted from Corbitt and Mensching, 2000)	**ERP Integration Maturity** (Antonucci et al., 2004)
Faculty Team: Curriculum coordination, infrastructure coordination, retention.	**Level 5.** Cross-discipline team manages and optimizes curriculum for effectiveness, efficiency and consistency. Integrated courses offered in all business disciplines
Funding: Hardware, software, salaries, facilities, etc.	**Level 4.** Curriculum integrates courses & concepts in multiple disciplines. Extended ERP concepts are introduced.
Infrastructure: Technology, staffing, processes, facilities.	**Level 3.** Several courses, concepts, and/or modules involved and placed in context of ERP big picture. Relationship between course curricula defined and maintained.
Employer Involvement: Interaction with industry regarding curriculum design, implementation and execution as well as student placement.	**Level 2.** One or more courses defined with concepts or modules. Relationships between courses are not well defined. Big picture of ERP is lacking from integration
Pedagogy: Lecture, simulation, experiences, media, group dynamics, etc.	**Level 1.** Curriculum not defined. Key individuals provide heroic efforts. No process awareness.
Leadership: Within the curriculum integration effort and more generally.	

Figure 1. Resources required / challenges to be faced and possible integration levels for ERP curricula

one junior course were modified to include approximately one-third ERP content and two upper-level courses were added with one-hundred percent ERP content. One of the senior level courses is a SAP overview course which discusses the details of a variety of common business processes with respect to SAP processing (Mandal and Flosi, 2012). The final senior level course delves into SAP configuration challenges and requires an A or B from the SAP overview course (Mandal and Flosi, 2012). Only the first two classes are required for every business major and the latter two courses are intended for MIS majors only.

At the other end of the spectrum, demonstrating a wider, more comprehensive model of integration, is the College of Business at California State University, Chico (CSUC) which began integrating ERP into Operations Management courses and this discipline remains the most heavily integrated. The initial one-discipline integration required the work of multiple faculty from many disciplines (Boykin and Martz Jr., 2004). CSUC was the first to be designated a University Competency Center for the ERP vendor SAP (Sager, et al., 2006). In 2006, CSUC delivered an ERP-IC using fifteen different faculty members for six Management Information Systems courses, six Accounting courses, six Supply Chain Management courses, and one course each in Finance, Marketing, and Management (Sager, et al., 2006). CSUC leads the way in curriculum integration and has reported some quantitative data regarding the benefits to their students and university (Sager, et al., 2006).

In Figure 1, the Resources/Challenges column, coming from Corbitt and Mesching (2000) as well as a general consensus in research, can be summarized as follows:

- **The Faculty Team** is an important component and getting that team to agree on curricular changes and degree of integration is critical. Faculty also may or may not be heavily involved with the infrastructure category. Faculty retention is key since one major threat to an effort is that faculty become discouraged, see no credit being given for efforts, and find opportunities abound elsewhere for faculty with ERP skill sets. This category is greatly influenced by the Leadership category since it is clear that administration policies and practices of the department, school, and university may heavily influence faculty career decisions.
- **Funding** can range from facilities necessary for pencil-and-paper study of ERP, through simulations and games using hosted systems, to fully implemented hardware/software platforms on premises. In addition, funding for faculty can influence the availability of skills and reputations that will influence other categories.
- **Infrastructure**, as suggested above, can vary widely but must address not only technology but staffing and facilities in support of the curriculum integration effort.
- **Employer Involvement** a broader category that encompasses "managing the recruiting activities of companies recruiting the students" mentioned in Corbitt and Mensching, (2000) and is also addressed directly and indirectly in other research.
- **Pedagogy** has become a significant thread in the literature as researchers campus-wide begin to bring issues and models to bear from other disciplines beyond the Business School. These include lectures, "flipped" courses, experiential labs, internship experiences, video, simulations, role play, games and group dynamics; the research has become a microcosm of the greater body of research on teaching/learning methods.
- **Leadership,** as already noted, is important for faculty retention and also for visibility and the credibility of the integration effort. Leadership issues occur at several levels such as inside the integration effort itself, as well as the value placed on integration efforts by department chairs, school deans, provosts, vice presidents and presidents of institutions. Leadership may even include boards, regents, and accreditation bodies when it addresses broad curriculum changes and any regulations or processes governing those changes. Strong, Johnson and Mistry (2004), in particular, stress the importance of leadership.

Not only do these categories influence each other but they also greatly influence what an ERP curriculum integration effort can accomplish. As shown in the second column of Figure 1, Antonucci, et al. (2004) identify five levels of ERP integration maturity. Based on published research which includes ERP curriculum integration details, integration level one or two are commonly achieved but integration level four or five are rarely accomplished (as shown in Table 2). It is not clear what factors are responsible for the difference in success or whether universities lower on the integration level will experience any of the benefits found by the ERP curriculum integration experts working at integration maturity level four or five.

3. ERP SKILLS NEEDED, TAUGHT, AND ASSESSED: A COMPARISON

3.1 ERP Skills Needed

Research has identified ERP skills that businesses expect as well as Critical Success Factors (CSFs) for ERP implementations. To ensure a complete understanding of the ERP competencies needed, both of these areas are considered. First, the knowledge and skills that businesses expect in graduates from ERP-integrated programs are examined (Boyle and Strong, 2006). Second, the CSFs for successful ERP implementations are discussed (Frimpon, 2012).

Business Functional Knowledge was rated as the most important skill for ERP-integrated programs; this is described as the ability to understand the business environment, business problems, and business functions (Boyle and Strong, 2006). Business programs consider this a core concept regardless of ERP systems use. This area was followed in order of importance by Technology Management Knowledge, Interpersonal Skills, and then Team Skills and Knowledge (Boyle and Strong, 2006).

These skills are needed by any business major hoping to be a successful manager in a digital organization. Interestingly, of the five areas of skills and knowledge evaluated by businesses, ERP Technical Knowledge was rated the least important skill for graduates of ERP-integrated programs (Boyle and Strong, 2006). In fact, most of the skills identified, except for this least important skill, can be and are taught without any hands-on enterprise system interaction. Further, the ERP Technical Knowledge category (Boyle and Strong, 2006) contained many general IS related skills which are frequently taught without the

specific use of ERP systems. In that list are skills such as Networking, Systems Analysis and Design and Relational Databases.

The CSFs for ERP implementations were defined by several researchers, but most recently by Frimpon (2012). Frimpon grouped the CSFs by roles for the purpose of analyzing and reducing project complexity. The categorization that results (See Table 1) is useful from an education and skills perspective because the categories give some indication of where in the curriculum the skills might be found.

The CSF categories and skills can be compared to a standard IS curriculum, say the IS 2010 curriculum for example (Topi et al., 2010). Appendix 2 highlights the coverage of topics related to the CSFs in the IS 2010 core and elective courses. Note that "coverage" is quantified without weighting. For example, "Testing & Troubleshooting" may be given intense coverage in a course on applications development but minimal coverage in a broad foundations course such as the standard Introduction to MIS. Appendix 2 gives both courses equal weight to simply demonstrate that, for most CSFs, coverage will occur multiple times over a student's progression through her program regardless of ERP integration. ERP-ICs can be shown to cover important curriculum requirements, as in Jensen et al., 2005. Evidence does not suggest that any curriculum requirements can be met only through using an ERP-IC.

3.2 ERP Skills Taught

With few exceptions, business schools that integrate ERP curricula do so primarily in MIS and Accounting courses (Mandal and Flosi, 2012). Though there is some evidence of ERP activities being integrated into supply-chain management, human resources, finance, and marketing courses (McCann and Grey, 2009). In 2003, Bradford, Vijayaraman and Chandra, found that only fifteen percent of thirty-five ERP curriculum adopters had integrated across more than two disciplines. A question that remains unanswered is whether the skills attainable through a hands-on ERP curriculum are ERP *implementation* skills or, as implied in most of the literature, skills necessary for successful *use* of ERPs. This is a key issue for programs evaluating the addition of the technology since many broad educational goals of a general business and operations nature may be served by skills related to *use*, but most of the research on the topic are authored by IS/IT faculty where the emphasis is on *implementation* and *support*. Thus, IS/IT faculty may be dedicating significant efforts to an ERP curriculum integration effort that only marginally aids their own students in their future jobs. Based on the assertion that technology is rarely as problematic as the cultural, process, personnel, and managerial aspects of an enterprise implementation (*e.g.*, Wallace, 2011) and given the lack of advanced IS skills taught in the majority of documented ERP curricula, it can be argued that ERP-ICs do not belong in upper-level MIS courses. Research to define the best courses providing the highest return on investment for ERP integration would be an important addition to the current literature.

Many ERP-integration efforts aim to enhance students' understanding of business processes and information flow across functional boundaries within an organization (Becerra-Fernandez, Murphy and Simon, 2000; Hawking, Ramp and Shackleton, 2001; Kanthawongs, Wongkaewpotong and Daneshgar, 2010; Mandal and Flosi, 2012; O'Sullivan and Stewart, 2010; Watson and Schneider, 1999). The importance of teaching business processes is emphasized by Stevenson (2007) who found that, before instruction, even graduate students lacked fundamental knowledge in that area. Other researchers described their integration as a tool that enables students to apply business processing concepts normally covered only by theory in the classroom (Becerra-Fernandez, Murphy and Simon, 2000). Though it appears only one-third of the faculty teaching ERP-IC actually include cross-functional business topics (Bradford, Vijayaraman and Chandra, 2003).

Some IT skills taught to students during classroom exercises with ERP systems (such as the table changes described in Bradford, Vijayaraman and Chandra, 2003) are not especially useful knowledge-building skills for MIS majors. Advanced configuration changes were described as creating accounts, account groups, assigning company codes to credit control areas, defining plants and storage locations and defining distribution channels for the company's products (Stevenson, 2007). These advanced activities may be skills more likely to fit with IT/IS student skills, but it is difficult to describe many of these as advanced IT/IS skills. The table found in Appendix 3 summarizes the business processes and/or courses specifically mentioned in ERP curriculum integration research.

3.3 ERP Skills Assessed

In one study, Hawking, McCarthy and Stein (2004), report

	Roles				
Critical Success Factors (CSFs)	Top Management	Technology Management	Process Management	Change Management	Project Management
	• Vision & Goals • Version • Strategy • Support • Decision Delegation • Champion	• Configuration • Data Accuracy • Hardware & Software • Performance • Testing & Troubleshooting	• Customization • Consultants • Vendor • Standardization	• User Involvement • Organizational Culture • Education & Training • Discipline • Commitment	• Needs Assessment • Staffing • Team Composition • Formalized Plan • Coordination • Partnership • Scope Management • Leadership

Table 1: CSFs Categorized by Role. Adapted from Frimpon (2012)

that fifty percent of the students "would not mind" spending more time to learn how to use SAP. It is uncertain whether this result indicates an acceptance of enterprise technology or a resignation to it. Another study reports that forty-two percent of the students believe the SAP knowledge gained will help them in their career (Mandal and Flosi, 2012). The percentage of students responding positively does not clearly mark the effort a success. Mandal and Flosi also added a certification course into their curriculum with varying degrees of success each semester based on the students' commitment to studying outside of class. Clearly, student commitment plays a role in learning but it is unclear if demand for ERP skills in the market surrounding a university influences student commitment and therefore, student learning in ERP-integrated courses.

If, as Stevenson (2007) suggests, the insight necessary to create successful ERP-integrated experiences is more likely possessed by graduate students. It is unclear whether undergraduate ERP curriculum integration efforts provide students with real appreciation and business insight. Though the research frequently claims a goal of greater student understanding of business processes, data flow, decision making, and many other business related information skills, quantified evidence of improvement in these areas is not typically provided. Some evidence exists showing students exposed to ERP software experiences do not necessarily gain enhanced learning or increased understanding (Kanthawongs, Wongkaewpotong and Daneshgar, 2010).

While courses that address ERP-related skills (such as the IS 2010 "Enterprise Systems" elective) may provide more detailed coverage of some factors in the curriculum (see Appendix 2), it remains to be proven that investments in ERP systems for curriculum support can provide significant benefits over and above those offered in curricula without such systems. In fact, Esteves and Pastor (2000), while noting that some IS skills and knowledge may be more important in the context of ERP implementation due to the complexity of ERP projects, they also acknowledge that "An important aspect is that most of the factors found can be considered 'classics' since they are not specific to ERP implementations" (page 8).

One study surveyed three groups of students: undergraduate students before they completed any ERP-integrated coursework; students who had completed 'significant' ERP coursework; and former students, post graduates, who had completed their degree within the previous two years (Boykin and Martz Jr., 2004). The survey measured recognition and understanding of business processes in organizations. Improvement in this understanding was found between the pre- and post-evaluations of students in an ERP-integrated course; however, the study also showed improvement between post-ERP coursework students and recent graduates who are working in their field. They did not identify if there is a difference between ERP coursework graduates and non-ERP coursework graduates within two years of their graduation. That gap is an example of what might be identified as a specific, quantifiable benefit of curricular integration: how many months or years of on-the-job experience might a mature ERP-IC replace?

Appendix 4 summarizes the assessment methods and results found in ERP-IC research. It is interesting to note that universities describing an ERP-integration level of 5 (per Antonucci et al., 2004) have provided the most quantifiable and detailed benefits. California State University, Chico (CSUC) documented increases in salaries for MIS and Accounting students with *intensive* ERP courses (Sager, et al., 2006) as well as an increase in business process understanding for students who have taken more ERP-integrated coursework (Boykin and Martz Jr, 2004). However, Boykin and Martz Jr. also noted an increase in business process understanding for graduated students with two years of experience. The research did not compare those students' knowledge against the knowledge of graduated students without ERP-integrated coursework so it is difficult to determine if the ERP-integrated coursework has a lasting improvement. The Sager et al. research examining starting salaries did not account for other variables which likely influence starting salaries such as internships or job experience. Central Michigan University performed similar research and found that the more ERP- integrated courses a student took, the greater their starting salary increased (except for Economics, Human Resources, and Logistics/Marketing degrees in the years 2006-2007) (McCann and Grey, 2009; Andera, Dittmer, and Soave, 2008). It is unclear how much the surrounding job market influences the results both universities experienced.

Two universities whose ERP-integration descriptions draw us to conclude a lower level of maturity are Western Michigan (Rienzo and Han, 2011) and University of Sydney (Seethamraju, 2007). Both performed quantitative research involving student business process and ERP transaction knowledge but found limited improvement. The majority of the research in Appendix 4 examines student or faculty perceptions.

Fedorowicz, et al. (2004) argue that a large-scale enterprise system integrated into the business curriculum "Exposes students to elaborate interdependencies" and "Imbues in students a deeper appreciation for the capabilities of ES than can be gained [from bookwork]." The article concludes with an appeal for specific research on the inherent value of ES integration for classroom learning and career success. It would seem the field has not advanced much in nearly ten years.

The question, then again, is whether the skills resulting from undergraduate curricula providing hands-on ERP experiences are substantively different from the skills students attain from more traditional curricula such as those based on the IS 2010 as defined by Topi, et al. (2010). Apart from the cataloging of different skill sets, it will be necessary to establish measures of difference that can be used to provide empirical evidence of improved learning.

Vendors do recognize the advantage of business graduates with ERP skills for their specific systems, but no measureable advantage has been documented for a business program to choose one vendor's system over another (Bradford, Vijayaraman and Chandra, 2003). It may be that the support provided by SAP, as noted by many authors, is the differentiating feature schools value most. (See, for example, "Section IV: Industrial Support of ES Education" in Targowski and Tarn, 2007).

Paper	Integration Level
Alshare and Lane, 2011	Level 1: Students in three courses which covered similar material were surveyed.
Becerra-Fernandez, Murphy and Simon, 2000	Level 3 or above: Track based curriculum developed by cross discipline team.
Davis and Comeau, 2004	Level 2 or above: Only one capstone course is described however, this course focuses on 'big picture' concepts such as ERP configuration and effectively managing a business using an ERP system.
Fedorowicz et al., 2005	Level 4 or above: Multiple courses in multiple disciplines
Hawking, McCarthy and Stein, 2004	Level 5: Multiple, cross-discipline courses with plans to advance curriculum toward the next-generation of ERP-integrated curriculum examining strategic issues.
Kanthawongs, Wongkaewpotong and Daneshgar, 2010	Level 1: One course using a control and experimental group.
Mandal and Flosi, 2012 Mandal and Saputro, 2008	Level 3: IS Discipline developed Freshman, Junior level ERP-integrated business courses. SAP Overview, and SAP Configuration also offered by IS Discipline.
Andera, Dittmer and Soave, 2008 McCann and Grey, 2009	Level 5: Cross-discipline use and visibility of all class transactions illustrating division of activities within real-world organizations.
Noguera and Watson, 2004	Level 1: Experiment established one hands-on ERP group, one ERP simulation group, and one control group with no ERP exposure beyond lecture.
Rienzo and Han, 2011	Level 1: Introduction to Information Systems course
Sager, et al., 2006 Boykin and Martz Jr., 2004	Level 5: Multiple, cross-discipline courses providing different ERP experiences.
Seethamraju, 2007	Level 1: One post graduate course within the Business Information Systems program
Stevenson, 2007	Level 1: One course with one instructor
Winkelmann, and Leyh, 2010	Level 1: One seminar given at three universities using the same pedagogy.

Table 2: ERP curriculum integration levels based on reported features

4. COMPARING THE COSTS AND BENEFITS OF IMPLEMENTING ERP-ICs

4.1 Benefits

Stevenson performed a qualitative evaluation of student experiences with ERP-ICs via an open survey (Stevenson, 2007). In the published comments from this study, students discussed their perception that the ERP experiences would provide them with a competitive advantage in the job market and also that the reflection and team-working activities that were a part of their ERP assignments greatly enhanced their learning (Stevenson, 2007). Similarly, some programs seek to increase ties to industry while helping students seeking jobs (Mandal and Saputro, 2008; Watson and Schneider, 1999). Mandal & Saputro (2008) supply SAP experienced students to a geographical area that has a focused, steady demand for SAP skills. No data was provided regarding how ERP inclusion affected the job placement rates.

A few studies have shown that starting salaries for students with SAP experience are higher than salaries for students without SAP experience (Andera, Dittmer and Soave, 2008; Sager, et al., 2006).

One study showed that starting salaries continued to rise for students taking more SAP integrated courses (Andera, Dittmer and Soave, 2008). For institutions serving a market with strong SAP skill demand, this is an important consideration. For a market where the ERP system skill demands are more varied, it is not clear if the investment in a single ERP system will provide similar salary differences.

4.2 Costs

Available resources, more than any other factor, influence the decision to integrate an ERP system into the curriculum. Hosted ERP systems available from some vendors help faculty avoid implementation and maintenance efforts (Esteves, Pastor 2001). If faculty want to support an ERP system themselves, training and support are provided by many vendors. ERP systems typically come with a sample company and business data. Specific cost data for different ERP systems is lacking beyond participation fees for system use.

ERP implementation and configuration courses are taught by some researchers. It is unclear if the students from those courses influence the success of ERP implementations and upgrades for their future employers.

Fedorowicz and her colleagues (2004) plead for additional research: “Much remains to be learned about the extent of the impact of ES integration in a curriculum. Little research has been published that measures the effects on student understanding of course material and their broader knowledge of business issues. Employers, career services and placement offices would benefit from knowing if and how much this coverage affects employment opportunities

and pay scales. Other issues related to best practices in teaching methods and learning assessment are open to study. As we continue to learn more about improving student education around ES, we urge our colleagues to use the opportunity to conduct field and experimental research to measure the true benefits of our work in this area."

4.3 Future Research Needed on Costs and Benefits

It is clear that the some gaps remain in the research. Faculty finding success in their own programs may not expend the extra effort required to quantify benefits and costs. Some report that occasionally, universities look upon their own ERP curriculum integration experiences as a 'competitive edge' and have no desire to share enough details to allow others to repeat or improve upon their curriculum (Hawking, McCarthy and Stein, 2004).

In order to assess current ERP curriculum integration efforts and to direct the future of ERP-ICs for the benefit of students, employers, and business schools, quantifiable research is needed. The following recommendations could be undertaken immediately.

1. Define a pre- and post-assessment mechanism which examines students' ERP knowledge as well as their understanding of the CSF (as identified by Frimpon, 2012). This assessment should be independent of any ERP vendor. The mechanism can be validated by assessing ERP users in industry before assessing students under ERP curriculum. Once validated, the mechanism can be shared among academics to allow comparison of many ERP-curriculum variables such as undergraduate versus graduate students or the impact of the different curriculum integration levels.

Assessing students skills related to ERP CSFs is extremely difficult. CSFs are directly related to the organizations involved in implementing an ERP system as illustrated by the CSF assessment performed by Sun, Yazdani, and Overend (2005). Further, Shaul and Tauber (2013) state in their literature review of ERP system CSFs that the complexity of ERP systems, and the organizational, technological, and behavioral impacts of those systems are, by their nature, intangible and evolving over time. How CSFs are addressed depends on the implementing organization and the available resources (Shaul and Tauber, 2013). Thus, assessing student recognition and understanding of the ERP CSFs through questions or case studies should suffice in assessing if students are capable of recognizing and addressing these factors as part of an ERP implementation team.

2. Define an ERP Learning Curve. It is generally acknowledged in ERP research that organizations will not see performance improvements for four or five years after an ERP implementation. It is not clear if this time frame can be shortened with improved ERP experience and knowledge. Certainly, a lack of training or a poor ERP implementation can delay or obliterate any organizational performance improvements. However, by comparing ERP-integration levels against student assessment results, an ERP learning curve can be identified. This will inform organizations and academics when diminishing returns on ERP education might begin. Although this would benefit academic programs, research has shown that business organizations achieve greater ERP benefit and operational abilities when ERP training continues post implementation (Chang and Chou, 2011). Thus, an ERP learning curve may or may not benefit and inform industry.

3. Define ERP placement rates in relation to integration level and overall placement rates. Sager et al. (2006) collected some data regarding student placement and salaries and found that ERP curriculum graduates, in general, received higher salaries and were in greater demand than their peers without ERP curriculum experiences. This type of data collection is difficult as it typically involves cooperation with multiple departments across a university campus, such as alumni relations, career services, and the academic department. Though to achieve the most useful data, collection should begin as soon as possible, even if only self-reported by students upon graduation. Without this data, it will be difficult to quantify the benefits of ERP curriculum investment to university administration no matter how enthusiastic faculty may be over the results of items 1 and 2 above.

Once data from the recommended steps above is collected and disseminated, there are many interesting areas that can be investigated to help guide the evolution of the ERP curriculum experience. The following questions arose from our examination of the current research:

1. What performance differences do organizations see as a result of the students' ERP-integration experiences? Are organizations more successful with ERP projects after ERP graduate hiring? For example, Madapusi and D'Souza (2012) argue that operational performance of a firm is improved through the advanced use and refinement of the firm's ERP system but evidence has yet to be found showing ERP graduates progressing more quickly to advanced user status or linking ERP graduates with an improved ability to adapt an ERP system to a firm's specific needs. Esteves and Pastor noted as early as 2001 that no data has been reported showing ERP markets are satisfied by "ERP academic knowledge" (Esteves and Pastor, 2001).

2. Are performance improvements dependent on a particular level of ERP integration? Significantly, the few quantifiable benefits documented using ERP-ICs have come from universities with advanced curriculum integrations (level four or five). At what point do students and employers experience benefits? Are the benefits related to particular business processes, ERP modules, or the number of courses integrated? The length of experience with an ERP system is related to a firm's operational performance (Madapusi and D'Souza, 2012) so a similar relationship to ERP exposure and student performance may be likely.

3. Do the effects depend upon the implementation of particular modules, coverage of particular business processes, or emphasis on local job markets? In that same article, Madapusi and D'Souza showed that the Quality, Controlling, Plant Maintenance, and Production Planning modules of ERP systems are the most correlated to firm

performance improvements. While six modules were shown NOT to contribute significantly to firm performance: project system, sales and distribution, human resources, SCM, CRM, and E-commerce models (Madapusi and D'Souza, 2012). Their sample came from manufacturing firms and "can be considered as representative of India's production sector" (p. 29). Should universities examine the breakdown of industries within their graduates' job market before choosing the modules to integrate?

4. Do placement rates change in a predictable fashion following ERP curriculum integration? Sager and colleagues (2006) report interesting, but also puzzling results related to the intersection of GPA and ERP/Non-ERP graduate salaries. The authors reveal shortcomings of the study data. They also suggest other factors to include when examining student salaries and ERP curriculum experiences including the size of the company making the offer, the geographic location of the company, the past work experience (including internships) of the student, as well as interviewing savvy and negotiation skills (Sager, et al., 2006).

5. How does the development of skills (especially those related to critical success factors) differ between students trained in ERP-ICs and those trained based solely on theory? This may be the most basic question for researchers in this area. Without demonstrated difference in skill sets or understanding, can there be expectation of differences in hiring, compensation or value-added for potential employers in the long run? Consequently, can universities expect value from their integration efforts if available resources limit their ERP-integration level to level one or two?

6. If students gain greater knowledge from ERP curriculum integration efforts, is that knowledge vendor-neutral? Does the job market view these student experiences as an increase in the students' value to any employer regardless of the employer's ERP vendor? This is an important question for vendors who plan to offer curriculum support, as well as academics who plan to match their curriculum to business need in their community of influence.

7. Will different research methods lead to better understanding? Most methodologies used in researching ERP curriculum integration have been case-study and survey approaches. For a better understanding, more experimental and quasi-experimental approaches are needed. (See, for reference, Shadish, Cook and Campbell, 2002.) Now that the research has reached a certain level of inquiry, more formalization of the effort is needed including more attention to quantitative methods and research design. In the IS literature, Benbasat, Goldstein and Mead (1987) emphasize the role of case studies and evoke Fritz Roethlisberger (1977) of Hawthorne studies fame to say "Case research is particularly appropriate for certain types of problems," meaning those in which research and theory are at their early, formative stages as well as problems that are based in practice, are messy and have important experiential components. This thread of study has matured somewhat and it is important for different approaches to get more emphasis. Researchers in these projects must realize that they are in the middle of action research (Baskerville and Myers, 2004). That is, the researcher is concerned with creating organizational change (in this case curriculum change) and simultaneously studying the process (Babüroglu and Ravn, 1992). It should be noted that the potential for researcher bias in such research may be greater since "the researcher is the subject and the subject is the researcher" (Heron and Reason, 1997).

8. Does the history of curriculum inclusion for other types of innovations have anything that can be useful in understanding ERP integration into the Business curriculum? What can be learned from other types of curriculum changes? The article by Lerouge and Webb (2004) is one of very few that use an education model (in this case the Concerns-Based Adoption Model or CBAM) to

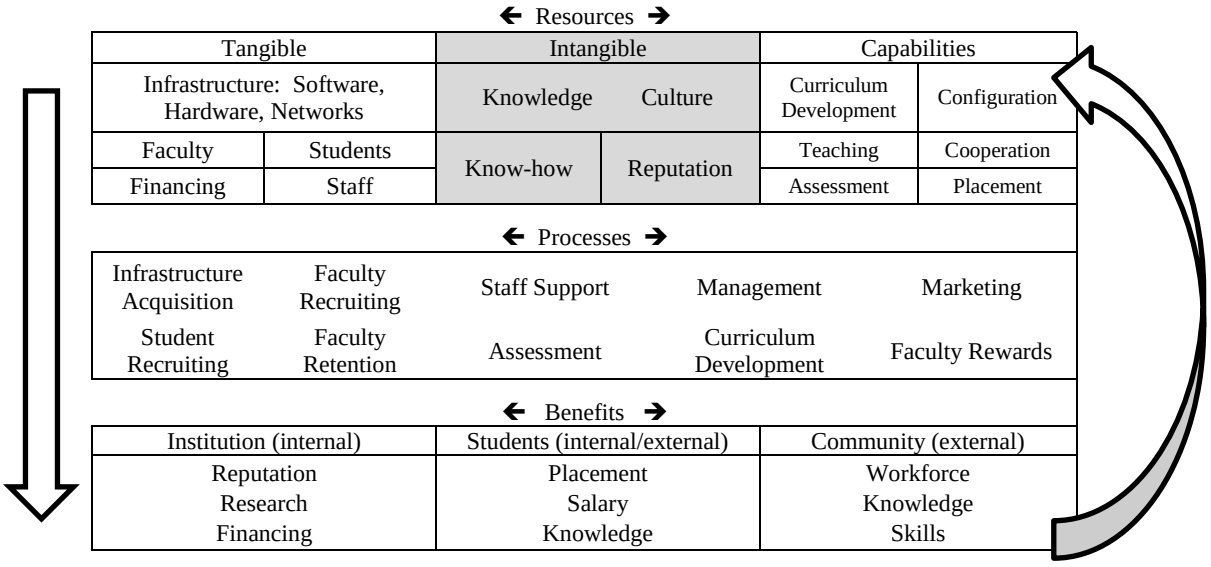

Figure 2. A Resource-Based Framework for Curriculum Integration

address the ERP-integration issue. Those authors create a hybrid model and cite evidence for the usefulness of models from the MIS literature (structuration theory in their case) along with the CBAM for investigation of MIS curriculum issues generally.

5. SUMMARY

A framework is valuable to facilitate discussion of factors influencing the costs and benefits of integrating ERP experiences into business curriculum, a Resource-Based view of the Curriculum Integration Framework is presented in Figure 2. A Resource Based view (RBV – see Wernerfelt, 1984 and Collis & Montgomery, 1995) can allow connection between the internal business processes and the external environment through application of resources (tangible, intangible and capabilities) to effects on the external environment.

This framework indicates the specific categories of resources and benefits that might be part of a curriculum-integration strategy for any institution. It is assumed that the benefits derived from application of resources through processes will further enhance resources. The specificity of the framework and especially the processes driving the connection between resources and benefits will require research efforts from the faculty community.

Faculty continue to ponder when, why, how, and for what purpose business technologies should be integrated into the core business curriculum (Davis and Comeau, 2004). Though numerous researchers report that an ERP-IC teaches the cross functional processes in business, very few have confirmed these claims with quantitative research. The quantitative research that does exist frequently acknowledges additional factors that could be examined to conclusively identify the benefits provided by an ERP-IC versus student internships, prior student experience, etc. For a college or department evaluating whether to make the significant investment in ERP integration, a cost-benefit case is difficult to make.

The Managing Director of SAP Australasia promotes several concepts for the future of ERP curriculum: 1) moving from transactional to strategic, 2) focusing on mySAP.com components, 3) focusing on ERP system's role in e-business, and 4) aligning with current technology and market trends (Hawking, McCarthy and Stein, 2004). It is unclear what commitment and resources are required to move ERP-ICs from a transactional, business process based approach to a strategic management approach. These future goals for ERP curriculum integration will clearly require a greater understanding of the underlying structure in an ERP system (Hawking, McCarthy and Stein, 2004). What ERP-integration level or curriculum experiences will be required to achieve this greater understanding? Will universities still analyzing the ERP curriculum integration decision be left behind?

It is our hope that researchers will help push the study forward by focusing on enriching the community's understanding of this environment.

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Appendix 1: Challenges in The Reviewed Literature

1. Faculty Team – curriculum coordination	2. Funding	3. Infrastructure
Becerra-Fernandez, Murphy and Simon, 2000 Boykin and Martz Jr., 2004 Bradford, Vijayaraman and Chandra, 2003 Corbitt and Mensching, 2000 Davis and Comeau, 2004 Edwards and Hepner, 2010 Fedorowicz, et al., 2004 Fedorowicz, et al., 2005 Guthrie and Guthrie, 2000 Hawking, McCarthy and Stein, 2004 Hawking, Ramp and Shackleton 2001 Hejazi, Halpin and Biggs, 2003 Johnson, et al., 2004 Joseph and George, 2002 LeRouge and Webb, 2004 Mandal and Saputro, 2008 Murphy, 2007 Noguera and Watson, 2004 Pharr, 2000 Stevenson, 2007 Stewart, Rosemann and Hawking, 2000 Strong, Johnson and Mistry, 2004	Andera, Dittmer and Soave, 2008 Becerra-Fernandez, Murphy and Simon, 2000 Bradford, Vijayaraman and Chandra, 2003 Corbitt and Mensching, 2000 Fedorowicz, et al., 2005 Hawking, Ramp and Shackleton 2001 Hejazi, Halpin and Biggs, 2003 Kanthawongs, Wongkaewpotong and Daneshgar, 2010 LeRouge and Webb, 2004 Murphy, 2007 Pharr, 2000 Sager et al., 2006 Strong, Johnson and Mistry, 2004 Watson and Schneider 1999	Becerra-Fernandez, Murphy and Simon, 2000 Bradford, Vijayaraman and Chandra, 2003 Corbitt and Mensching, 2000 Edwards and Hepner, 2010 Fedorowicz, et al., 2004 Fedorowicz, et al., 2005 Guthrie and Guthrie, 2000 Hejazi, Halpin and Biggs, 2003 Kanthawongs, Wongkaewpotong and Daneshgar, 2010 LeRouge and Webb, 2004 Mandal and Saputro, 2008 Murphy, 2007 Pharr, 2000 Strong, Johnson and Mistry, 2004 Watson and Schneider 1999
4. Employer Involvement	**5. Pedagogy**	**6. Leadership**
Alshare and Lane, 2011 Boyle and Strong 2006 Corbitt and Mensching, 2000 Davis and Comeau, 2004 Fedorowicz, et al., 2004 Fedorowicz, et al., 2005 Hawking, McCarthy and Stein, 2004 LeRouge and Webb, 2004 Murphy, 2007 O'Sullivan and Stewart, 2010 Pharr, 2000 Sager et al., 2006 Watson and Schneider 1999	Alshare and Lane, 2011 Bradford, Vijayaraman and Chandra, 2003 Davis and Comeau, 2004 Draijer and Schenk, 2004 Fedorowicz, et al., 2004 Fedorowicz, et al., 2005 Guthrie and Guthrie, 2000 Hawking, McCarthy and Stein, 2004 Hawking, Ramp and Shackleton 2001 Hejazi, Halpin and Biggs, 2003 Johnson, et al., 2004 Joseph and George, 2002 Kanthawongs, Wongkaewpotong and Daneshgar, 2010 Léger, 2006 LeRouge and Webb, 2004 Mandal and Flosi, 2012 Mandal and Saputro, 2008 Murphy, 2007 Nelson and Millet, 2001 Noguera and Watson, 2004 O'Sullivan and Stewart, 2010 Pharr, 2000 Rienzo and Han, 2011 Stevenson, 2007 Stewart, Rosemann and Hawking, 2000 Strong, Johnson and Mistry, 2004 Wagner, Najdawi and Otto, 2000 Watson and Schneider 1999	Aladwani, 2001 Becerra-Fernandez, Murphy and Simon, 2000 Bradford, Vijayaraman and Chandra, 2003 Fedorowicz, et al., 2005 Guthrie and Guthrie, 2000 Johnson, et al., 2004 LeRouge and Webb, 2004 Murphy, 2007 Pharr, 2000 Sager et al., 2006 Strong, Johnson and Mistry, 2004 Watson and Schneider 1999

Appendix 2: Critical Success Factors Categorized By Role

The following table is adapted from (Frimpon, 2012) and compared to the IS2010 Curriculum (Topi, et al., 2010).

		IS 2010 Core Course							IS 2010 Elective Courses							CSF Coverage in IS 2010	
Role	CSFs	Foundations	Data & Information Management	Enterprise Architecture	IT Infrastructure	IS Project Management	Systems Analysis & Design	IS Strategy, Management, & Acquisition	Application Development	Business Process Management	Enterprise Systems	Intro to Human-Computer Interaction	IT Audit & Controls	IS Innovation & New Technologies	IT Security & Risk Management	Coverage in Core	Coverage w/ Electives
Top Management	Vision & Goals	■	■	■		■	■	■			■			■	■	6	9
	Version				■											1	1
	Strategy	■	■	■		■		■			■			■	■	5	8
	Support	■	■		■				■	■		■	■		■	3	8
	Decision Delegation	■				■		■		■	■		■		■	3	7
	Champion	■	■			■		■		■	■		■		■	4	8
Technology Management	Configuration	■	■	■	■		■		■	■	■		■		■	5	10
	Data Accuracy	■	■			■			■			■	■		■	3	7
	Hardware & Software	■	■	■	■				■		■	■	■	■	■	4	10
	Performance	■	■	■	■		■		■	■	■	■				5	9
	Testing & Troubleshooting	■				■			■	■		■	■		■	2	7
Process Management	Customization	■			■	■	■	■	■	■	■	■	■		■	5	11
	Consultants					■		■		■	■		■	■	■	2	7
	Vendor					■		■		■	■			■		2	5
	Standardization			■	■	■	■	■	■	■	■		■		■	5	10
Change Management	User Involvement	■				■	■	■	■	■	■	■	■		■	4	10
	Organizational Culture	■				■	■	■		■	■	■	■		■	4	9
	Education & Training	■									■	■	■	■	■	1	6
	Discipline	■	■	■	■	■	■	■	■	■	■	■	■		■	7	13
	Commitment	■		■		■		■		■	■		■	■	■	4	9
Project Management	Needs Assessment	■		■		■	■	■	■	■	■	■	■	■	■	5	12
	Staffing	■		■		■		■	■		■	■			■	4	8
	Team Composition	■		■		■		■		■	■		■		■	4	8
	Formalized Plan	■		■		■	■	■		■	■		■		■	5	9
	Coordination	■		■	■	■	■	■		■	■		■		■	6	10
	Partnership	■		■												2	2
	Scope Management		■	■		■	■	■	■				■		■	5	8
	Leadership	■				■		■								3	3

Appendix 3: Courses, Business Processes Taught Using ERP-Integrated Curricula

Paper	Courses / Business Processes
Alshare and Lane, 2011	**Business Processes:** Sales Order, Production, and Purchasing
Andera, Dittmer and Soave, 2008	**Courses:** Information Systems, Managerial Accounting, Integrated Business Experience
Becerra-Fernandez, Murphy and Simon, 2000	**Courses:** Operations Management, Managerial Accounting, and Marketing Management
Boykin and Martz Jr., 2004	**Courses:** Production Planning and Management, Production Control and Scheduling, Quality Management, and Procurement
Davis and Comeau, 2004	**Course:** Enterprise Integration
Fedorowicz, et al. 2004	**Business Processes:** Order-to-cash, Purchase-to-pay
Fedorowicz, et al., 2005	**Courses:** Accounting Information Systems, Advanced Accounting Information Systems, Financial Accounting and Reporting, Short-Term Financial Management, Financial Statement Analysis for Decision Making, Cost Management, Advanced Topics in Cost Management, Corporate Treasury Management, IT Auditing, and Business Process & Systems Assessment
Hawking, McCarthy and Stein, 2004	**Courses:** 25 undergraduate and graduate subjects including visiting instructors for specialized courses
Kanthawongs, Wongkaewpotong and Daneshgar, 2010	**Course:** Business Processes
Mandal and Flosi, 2012	**Business Processes:** Order Processing, Purchasing, SAP Configuration
Mandal and Saputro, 2008	**Business Processes:** Sales, Purchasing, SAP Configuration
McCann and Grey, 2009	**Courses:** Introduction, Programming, Configuration, Supply-Chain Management, Human Resources, Finance, Marketing, Information Systems, Accounting
Noguera and Watson, 2004	**Business Process:** Manufacturing planning and execution cycle
Rienzo and Han, 2011	**Business Processes:** Sales Cycle and Purchasing Cycle
Sager, et al., 2006	**Business Processes:** Order to Cash, Order to Pay, Production Planning and Execution, HR Recruitment to Hire, and *ERP Intensive courses* which cover ERP Configuration, ERP Administration, ERP-to-ERP system Integration **Courses:** 6 MIS courses, 6 Accounting courses, 6 Supply Chain courses, 1 Finance course, 1 Marketing course, and 1 Management course
Seethamraju, 2007	**Business Processes:** Creation of Vendors, Customers, Materials, and Work Centers, Configure Processes, Order to Cash, Procure to Buy, Production of Management Reports
Stevenson, 2007	**Business Processes:** ERP Configuration, Buying Materials, Running Materials Resource Planning, Processing sales orders
Winkelmann and Leyh, 2010	**Business Processes:** Inventory, Product Pricing, Sales

Appendix 4: ERP Curriculum Assessment

Paper	Items Assessed / Method	Authors Conclusion
Mandal and Flosi, 2012	Student attitudes toward the use and effectiveness of the SAP ERP system, students' perceptions of the advantage of ERP skills when job hunting / Student opinion survey given post experience.	Students felt that they learned more about business processes, that ERP systems will improve the efficiency of business processes and make them easier to perform. Students also felt that the knowledge gained would help them in their career and that they would not mind learning to use SAP.
Rienzo and Han, 2011	Components of and sequence in sales business process and purchasing business process / Knowledge assessment given pre lecture, post exercise, and class end.	Only sales business process component knowledge was statistically improved through use of ERP course content.
Alshare and Lane, 2011	Student attitude, perceived learning, performance expectancy, effort expectancy, course structure, instructor knowledge, and student perceived ERP knowledge / Student opinion survey given post experience.	Based on the Unified Theory of Acceptance and Use of Technology, created a structural model containing course structure, hands-on training, student effort and performance expectancies, student attitude toward ERP, student satisfaction, and student's perceived learning outcomes. For ERP integration, authors found that • student attitude creates a higher level of satisfaction and higher level of perceived learning outcomes, • performance expectancy positively effects student attitude, • effort expectancy positively affects student attitude and performance expectancy, • hands-on training positively effects effort expectancy and performance expectancy, • student perception of course design and content positively effects effort expectancy, • perceived knowledge positively effects student satisfaction, and • self-reported ERP knowledge has a positive effect on student satisfaction and perceived learning outcomes.
Kanthawongs, Wongkaewpotong and Daneshgar, 2010	Student knowledge of business processes, learning from in-class versus web-based ERP simulation software. / Pre-test, post-test, and in-depth interviews	Students who learned about business processes through lectures, teamwork, role playing activities, and team presentations scored significantly better on business process knowledge than students using web based ERP simulation software and tutorials. Additional factors affecting the outcome were lack of social interactions with ERP software, absence of applying skills in native language during ERP simulations, lack of complete understanding of the requirements from students, and not being able to connect business process diagrams to actual screens of the simulation software.
Winkelmann and Leyh, 2010	ERP Knowledge and interest, motivation for learning ERP, ERP resource availability / Student opinion survey was given post experience.	Student groups were too small to provide statistically significant results. Students perceived that their ERP knowledge and interest increased as well as their motivation to learn about ERP system issues.

Paper	Items Assessed / Method	Authors Conclusion
McCann and Grey, 2009	Starting salaries for graduates with ERP-integrated experiences, by major and ERP courses, by number of ERP-integrated courses completed / Starting salaries similar to (Andera, Dittmer and Soave, 2008) were examined but broken down by major and number of ERP-integrated courses completed.	Students with ERP-integrated course experiences were offered higher salaries, on average, than students without the ERP-integrated course experiences from 1998 to 2007. When examining starting salaries by major, a positive difference in starting salary did not appear for Economics, Human Resources, and Logistics/Marketing degrees in 2006-2007. The number of ERP-integrated courses provided an increasingly positive affect on starting salaries between 1998 and 2005, then again in 2006-2007.
Andera, Dittmer and Soave, 2008	Graduates' starting salaries / Reported by the Central Michigan University's Career Services Office.	Students with one or more ERP courses receive, on average, a greater salary. The average starting salary for students taking ERP-integrated courses increases for each ERP related course taken.
Seethamraju, 2007	Business and process knowledge, as well as ERP interface, implementation, customization, management, and transaction knowledge / Pre-test and post-test given.	Students showed an increase in all knowledge areas but only a statistically significant increase in knowledge of ERP transaction skills.
Stevenson, 2007	Value of learning ERP, best part of learning experience, preference for paired or alone experience / Student opinion survey post experience was given.	Students self-reported that the course was valuable and felt it would improve their employability. Students preferred to work in pairs.
Sager, et al., 2006	Graduates' starting salaries / Self-reported by students to the university Career Planning and Placement office.	MIS and Accounting students completing one or more ERP intensive courses receive greater starting salaries regardless of their GPA, than MIS and Accounting students without the ERP intensive experience. In addition, those students without ERP intensive coursework encounter a significant correlation between their GPA and their starting salaries. Study did not control for students participating in internships.
Rosemann and Maurizio, 2005	Faculty and students experiences with SAP in the curriculum / Global opinion survey given via the web.	The four biggest issues identified by faculty were (1) knowledge acquisition and knowledge maintenance of complex, evolving SAP systems, (2) curriculum development (industry training and exercises lack a foundation in larger concepts that must be included in a university education), (3) students lack understanding of the underlying business scenarios or lack interest in enterprise system issues, and (4) gaining support from other faculty and the university. The five top issues for students were (1) complexity of the system, (2) system performance, (3) the user interface, (4) course materials, and (5) the learning approach (using hands-on experience, teamwork, etc.)
Boykin and Martz Jr, 2004	Student understanding of business processes / Tests given to Freshmen, Juniors, Seniors, and recent graduates of an ERP-integrated program.	Preliminary results show that students with more ERP course experiences exhibited greater understanding of the business processes. Graduates with two years of job experience significantly increased their understanding of business processes beyond the Junior/Senior level students.

Paper	Items Assessed / Method	Authors Conclusion
Davis and Comeau, 2004	Students' previous ERP knowledge/experience, value of various course components, perception of ERP skills and knowledge gained / Student opinion survey given post experience.	Students' responses were clustered based on previous experience and course components valued. Students with the least enterprise integration experience but some hands-on experience with SAP software were least confident in their ability to understand, generate business value from, contribute to the implementation of, and be an effective manager using an ERP system. Students with some enterprise integration experience and significant hands-on experience with an SAP system felt most confident about their ability to generate business value using an ERP system. Students with very little enterprise integration and very little SAP experience expressed confidence in their ability to utilize ERP systems and contribute to an ERP implementation.
Noguera and Watson, 2004	ERP system knowledge and manufacturing business processes, self-efficacy, and user satisfaction / Pre-test, -post-test, and student opinion surveys were given.	Results were not statistically significant due to sample size. Pre-experience exam showed the simulation and hands-on ERP students had greater knowledge/skills before the experiment began. Performance, self-efficacy and user satisfaction was higher among students who experienced hands-on ERP-integrated courses via an ERP simulation or an actual ERP system when compared to students who did not experience the course integrated with any ERP experience.
Becerra-Fernandez, Murphy and Simon, 2000	Educational Objectives of the ERP-integrated courses / Student opinion survey given post experience.	A new internship program and favorable reports from employers were named as evidence of program success.

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